its distance from its armature, is least, the greatest possible portion of the work being thus put upon the clockwork, and the least upon the battery.

This spring aids the electro-magnet, but does not in anywise reduce the effect of the reversing spring in holding the clutch to its work; so long as the base of that spring is unmoved, its action is unimpaired. The resistance of these springs occurs only during the ascent of the needle-bar, which is, therefore, counterpoised to excess, and the resistance and the motion are thus rendered uniform. By reason of the form of the clutch-teeth before described, there is no outward thrust upon the clutches while in action, and hence the reversing spring requires only to be strong enough to throw the arm over and to shift the clutches. The stop of the clutch-arm next the electro-magnet is an insulated plate, to which the battery-wire leading from the magnet is connected, so that as soon as the arm has left the stop the circuit is again broken, although the needle may for a short time remain in contact with the mercury; the recording-point is at once withdrawn, and thus makes upon the paper a single perforation which must be a true record of the position of the mercury in the tube, uaaffected by friction or other disturbing cause, since this action must always take place at the moment of contact of the needle with the mercury, and these dots or perforations are repeated at the end of each interval of time required for the needle-bar to ascend and descend the required distance, which will be about two minutes with the wheel-motion designated.

The graduation of the scale upon the paper must correspond with the movement of the mercury in the tube of the thermometer as accurately as the graduation of the scale of an ordinary thermometer corresponds with the movement of the mercury in its tube.

If but one instrument of this sort is to be made this is very easy, the rate of motion is ascertained, a scale is made to fit it, and the paper is ruled to that scale.

In all thermometers heretofore made the scale has been made to fit the tube, but if more than one of these instruments is to be made, it becomes necessary, or at least very convenient, to have one set of ruled papers that will fit all the instruments, and it then becomes necessary to reverse the practice and to make the tubes to fit the scale.

The rise and fall of mercury in a thermometer depends upon the proportion between the diameter of the tube and the volume of mercury in the tube and bulb, and while it is possible to construct these parts in such proportion as to obtain proximately a given motion, it is not possible thus to obtain it exactly.

The tube and bulb are made in separate parts, as shown in Fig. 1, of such size that when the tube is thrust half way into the bulb, the volume of mercury filling the tube half way at 32° Fahrenheit is as nearly as may be properly proportioned to the diameter of the tube. If now there be found too much motion, the capacity of the bulb is diminished by thrusting the tube further in, and *vice versa*, and the proper height of mercury at 32° for that purpose is marked upon the tube.

Mercury exposed to the air will slowly form a coating of oxide upon its surface. To prevent this, a small quantity of glycerin or of oil free from oxygen is placed in the thermometer tube above the mercury. If, notwithstanding, the oxide shall accumulate to an inconvenient extent, the observer in charge of the instrument will remove the thermometer from its place, and will put the bulb in warm water until the oxide is floated off. He will then supply the loss with pure mercury, determining the proper quantity by immersing the bulb in broken ice, when the mercury column should stand at the mark for 32°.

The whole apparatus, except the thermometer itself, can be inclosed, and so protected from the weather and dust, while the thermometer is exposed to the air below.

The system is equally applicable to a barometric record, in which case, on account of the small range of motion, the needle-bar is connected to a lever, thus increasing the range of the record.

SCIENCE IN BOHEMIA[1]

THE Bohemian Society of Science continues its useful career, which has already lasted for eighty-four years, and its latest publications (the *Memoirs*, the *Proceedings*, and the annual *Reports*) contain many valuable papers, devoted partly to science in general, but mostly to the exploration of Bohemia itself in its various aspects. The last volume of its *Memoirs* ("Abhandlungen" for 1879–1880, series vi. vol. x.) contains a series of very interesting papers, each of them being the result of careful and extensive research. Prof. Franz Farsky gives the results of varied experiments which were undertaken at the experimental agricultural station at Tabor, on the growth of food-plants in water containing solutions of those salts which constitute the ash of the plant. The influence of alkaline and acid solutions, and especially that of chlorine, which proved to be a most important element of vegetation, were submitted to varied experiments, all the results of which are published in full. The general reader will notice with interest the beautiful results obtained by the culture of oats and barley in glasses of water, which contained the necessary salts, the plant being simply planted in a bit of cotton. Dr. F. J. Studnicka publishes in the same volume the complete tables of observations on the amount of rain in Bohemia during the years 1879 and 1880, at no less than 312 stations in 1879 and at 289 stations in 1880. If we remember that besides these stations there are very many others established by the Bohemian Foresters' Society, and that the whole number of stations where the amount of rain is accurately measured day by day, amounts to 800, we can see that Bohemia has probably the widest network of ombrological observations in Europe. We notice that the most rainy places in Bohemia are Maader, Rehberg, and Neuwelt (1744, 1572, and 1505 millimetres per year respectively), all these situated at great heights (985, 848, and 683 metres), whilst the less rainy places are Rapic, Slaten, and Kladno (431, 438, and 456 millimetres), situated respectively at altitudes of 322, 246, and 380 metres.

Dr. F. Ullik contributes a paper on the matter suspended and dissolved in the water of the Elbe, at Tetschen. Samples of water were taken three times every day, and the samples of each day were analysed separately with regard to the matter suspended, as well as to the quantity of chlorine, ammonia, nitric acid, and organic substances. Besides, 22 complete analyses of different types of water, and 12 of ooze, were made. The water passing through the Elbe at Tetschen proved to be 9,903,510,660 cubic metres during the year October 15, 1876, to October 15, 1877), which contained 776,309,959 kilograms of suspended or dissolved matter. During the year 1877, the amount of water run was 9,456,939,810 cubic metres, which contained 36,557 metrical tons of K^2O, 69,631 tons of Na^2O, 266,081 tons of CaO, 48,915 tons of MgO, 120,553 tons of SO^3, 83,336 tons of chlorine, 778 tons of ammonia, and 11,196 of nitric acid. As to the sources of these immense quantities of mineral substances, Dr. Ullik points out that the amount which is supplied by waste water of manufactures and sewage is usually over-rated. Thus, if the well-known sulphuric acid manufacture at Aussig would pour all the acid it produces into the Elbe, it would give only 5000 tons of SO^3 per year, that is, only the 24th part of sulphuric acid anhydride contained in the waters of the river. The amount of mineral substance poured into the river by all the breweries of Bohemia would give only 401 tons per year, that is, the 1562nd part of all the minerals contained in the Elbe water. And, if all mineral substance contained in the sewage from the 5,000,000 inhabitants of Bohemia would reach the Elbe, it would yield only 33,250 tons, that is, 1·20th of what is really contained in the water of the river. Therefore, it is obvious that the chief source of these substances in the river-water must be sought for in the supply brought in by springs.—Dr. Siegmund Günther contributes to the same volume an interesting notice on the "Algorithmus Linealis," by Heinrich Strömer, which appeared in 1512, being one of the products of the revival of taste for mathematics which characterises, in Germany, the beginning of the sixteenth century. The same volume contains an elaborate paper on the Christian Calendar and on the methods of improving it, by Dr. W. Matzka; and a notice on the electrical clock of Rebicek, by Dr. A. Waltenhofen. It is worthy of notice that all papers that appear in the *Abhandlungen* are written in German, and are sold by the Society as separate pamphlets.

The *Sitzungsberichte*, or Proceedings, contain such a mass of valuable papers that we can notice only the more important of them. They are especially rich in mathematics, and we find (in the volume for the year 1879) papers by Dr. S. Günther, on the application of orthogonal co-ordinates to one problem of the potential theory; on the normals to parabolæ, by Dr. K.

[1] "Abhandlungen der Mathematish-Wissenschaftlichen Classe der K. Böhmischen Gesellschaft der Wissenschaften, vom Jahre 1879-1880, vi Folge, Band x. (Prag. 1881). "Sitzungsberichte" of the same Society, for 1879 and for 1880. "Jahresberichte" of the same, for 1879 and 1880.

Zahradnik ; a very interesting paper by Prof. Carl Pelz, on the construction of radii of curvature of conic sections, all considered as mere corollaries of one theorem of Steiner ; and several papers, by Dr. Franz Studnicka, concerning the theory of determinants and polynomes ; and by Prof. J. Solin, on graphical integration. ; Prof. A. Safarik contributes a paper giving the results of his observations on the Transit of Mercury on May 6, 1878. After having compared the photographs of the sun during the years 1875 to 1878, with observations on storms at Greenwich, Prague, and Vienna, Prof. Zenger arrived, as is known, at the conclusion that the 12·6 days' periodicity of "storms" on the surface of the sun had the effect of producing the same periodicity in the appearance of tornadoes in the West Indian and of typhoons in the Indo-Chinese Seas. Now, he discusses the storms noticed at Windsor (Australia) during the years 1863-75, and discovers in their appearance the same periodicity; the average deviations from it for the 29 duodecades of each year, being mostly but fractions of one day. But it must be observed that, for calculating the average error of these deviations, Prof. Zenger not only does not make use of the methods of least squares, but takes into account the *signs*, positive or negative, of the deviations, which method considerably diminishes the errors. Discussing Quetelet's tables of falls of meteorites, he arrives at the conclusion that these last also show the same periodicity. An elaborate paper, by Prof. Augustin, gives the results of thirty-eight year's observations of temperature at Prag, the averages being: winter, −0°·56 Cels. ; spring, 8°·77 ; summer, 19°·01 ; autumn, 9°·60 ; year, 9°·18.

Several communications are devoted to mineralogy, and we notice among them the papers of Prof. Krejci on the crystallisation of quartz, and on the homœmorphism of Sphalerite, Wurtzite, and Greenokit ; on transformation-symbols, by Dr. N. Daubrawa ; and on minerals from the Kuchelbad diabase, by MM. Preis and Urba. The papers on palæontology, geology, zoology, and botany, mostly deal with the fauna and flora, fossil or existing, of Bohemia itself. Dr. Ant. Fric gives a list of all fossil animals found in the coal and limestone of the Permian formation in Bohemia ; whilst only two species were known from this formation in 1868, M. Fric's list includes no less than 87 species, mostly labyrinthodonts and fishes. Dr. O. Novak publishes his researches on hypostoms of trilobites ; and Dr. O. Freismantel contributes three papers : on Nöggerathias of the Bohemian coal-fields ; notices on the *Nöggerathia*, Stbg., *Nöggerathiopsis*, Fstm., and *Rhiptozanistes*, Schmalh., and the description of a new Calamaria, *Discinites bohemicus*. M. K. Taranek gives a description of Diatomaceæ from Bohemian marshes ; Dr. J. Schöbl publishes the results of his researches on the reproduction of Isopod crustaceans ; and Dr. Ullik, the results of several analyses of Bohemian waters. In the Ethnographical Department we notice a paper by Dr. Jirecek, on Walachians and Mauro-Walachians, according to documents found at Ragusa.

The next volume of the *Sitzungsberichte*, for the year 1880, is as rich as the preceding one. Dr. F. Studnicka continues his researches on the theory of determinants, and describes a new property of them, already observed by M. Catalan ; and M. F. Mertens gives a new geometrical application of the rule of multiplication of determinants. Dr. A. Seydler studies the movement of a point on given curves and superficies. In the domain of physics we notice but one paper, by Dr. K. Domalip, on the alternating discharges of electricity in rarefied space, in which paper the author deals especially with luminous back-currents. The researcees of Prof. W. Zenger on the 12·6 days' periodicity, are continued in this volume. He remarks that this period is equal to one-half of the duration of each rotation of the sun, and tries to prove that the earthquakes in Southern Italy, from 1349 to 1873, as given by Prof. Suess, also fell on such days as closely coincide with the 12·6 days' period. He discovers the influence of the same periodicity in the dates of the passage of comets, from A.D. 371 to 1864, through their perihelium, as well as in the dates of meteoric showers. In further papers he tries to establish that the same periodicity might be discovered as to the maxima and minima of atmospheric pressure, of temperature, &c., and of magnetic disturbances. Finally, he shows that the sidereal durations of the revolutions of all planets are but multiples of the half rotation of the sun, and he finds that the same number appears also in the lengths of the months of the moon and of the satellites of Jupiter, Saturn, and Uranus. He concludes that "the cause of the movements in our solar system must be sought for in the rotation of the sun," and that all phenomena of gravitation, magnetism, and electricity are but modifications of the same cause which occasions the rotation of the sun. Dr. F. Augustin contributes a paper on the climate of Prag, being a *résumé* of the meteorological observations made since 1840, and another paper on the influence of clouds on the diurnal march of temperature at Prag. Among geological papers we notice : the communication by Dr. Fric on the discovery of fossil remains of a bird, *Cretornis Hlavaci*, in the chalk of Bohemia ("Iserschichten") ; the description of a new Tertiary Batrachian, *Palæobatrachus bohemicus* (H. v. Meyer), from the brown coal at Böhmisch-Kamnitz, very similar to the *Palæobatrachus Goldfussi*, but different from it in the structure of several parts of the skeleton. M. Carl Heistmantel contributes two papers on the fossil flora of the Hangend-ridge of the Kladno-Rakonitz coal-basin, characterised by the abundance of *Filices*, *Alethopteris Serli*, and *Cyatheites arborescens*, being most common, and appearing in masses, whilst the *Sphenopteris* is scarcely represented, the *Neuropteris*, so characteristic of the lower deposits, completely disappears, and the Lepidodendrons become very rare. The group of *Leiodermaria* becomes, on the contrary, most usual, and acquires a new representative in the Permian *Sigillaria denudata*, Göpp., whilst Conifers become more numerous. The flora acquires thus a decidedly Permian character. Mr. J. Woldrich contributes a paper on the diluvial fauna at Sudslavic, close by Vimperk ; it bears a decidedly northern character, as it contained remains of *Myodes torquatus*, *Nyctea nivea*, *Leucocyon lagopus*, *Fœtorius Erminea*, *Lepus variabilis*, *Arvicola nivalis*, *A. gregalis*, *Lagopus alpinus*, &c. Prof. A. Belohoubek gives an interesting sketch of the influence of geological structure on the chemical composition of water in very many springs and wells from different geological formations : old gneisses, Huron, Silurian, Carboniferous, Permian, Chalk, Tertiary, and Diluvium in Bohemia. The best water, as far as can be concluded from M. Belohoubek's researches, which he considers himself as only preliminary—is given by the Gneiss, Permian, and partly also by the Chalk ; the worst, by the Carboniferous and Silurian. Dr. Vejdovsky gives a list of Rhizopods inhabiting the wells at Prag, several species of *Amœba*, *Centropyrix*, *Euglypha*, *Trinema*, &c., being characteristic for special wells. M. Taranek gives a description of Diatomaceæ at Warnsdorf. Prof. J. Dedecek gives a sketch of Bohemian Polytrichaceæ, and deals in another paper with the distribution of Hepatic mosses in Bohemia.

In the *Annual Reports* we notice, besides the public lectures read at the annual meetings, a most useful, complete bibliographical indexes of works and papers published by different members of the Society since the beginning of their scientific careers.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—From the annual report on the local lectures in populous centres, we learn that 12 out of 23 courses of lectures in the Michaelmas Term of 1881, and 10 out of 20 courses in the Lent term of 1882, were on scientific subjects, and were delivered to audiences amounting in all to 1042 persons in the former term and 645 in the latter. This refers only to the work exclusively conducted from Cambridge, without including the courses of lectures in London and in the counties of Durham and Northumberland, which are also largely under the influence of the Cambridge system.

University College, Nottingham, has applied to be affiliated to Cambridge.

A further report of no progress has been made by the Sedgwick Museum Syndicate. It is estimated that 14,716*l.* is the present value of the investments and balances of the Memorial Fund. All that can be said as to the prospects of building is that further acquisitions of sites near the new museums make satisfactory proposals more possible. Prof. Hughes has addressed a letter to the Vice-Chancellor showing that a considerable proportion of the funds for building the present Woodwardian Museum and Library was sought and given expressly for a geological museum, so that the University may fairly be expected to find 15,000*l.* as the value of the present museum if it takes possession of it for the use of the Library.

The first part of the Natural Sciences Tripos has placed 24 men in the first class, 20 in the second, and 10 in the third, while